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Shashi; Cerchione, Roberto; Singh, Rajwinder; Centobelli, Piera; Shabani, Amir

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From a structured literature review to a conceptual framework and research agenda

Shashi
School of Management Studies, Punjabi University, Patiala, India
Roberto Cerchione
Department of Engineering, University of Naples Parthenope, Naples, Italy
Rajwinder Singh
School of Management Studies, Punjabi University, Patiala, India
Piera Centobelli
Department of Industrial Engineering,
University of Naples Federico II, Naples, Italy, and
Amir Shabani
Department of Information, Logistics and Innovation,
Vrije Universiteit Amsterdam, Amsterdam, The Netherlands

Abstract

Purpose – Since last few years, cold chain management (CCM) has gained growing interest among practitioners, policymakers, researchers and academicians. The purpose of this paper is to provide a review focused on food cold chain management (FCCM) over the last 16 years to identify state of the art in the literature, highlight research gaps and define appropriate research questions (RQs) for future research.
Design/methodology/approach – The paper analyzes the content of 89 research articles published on the topic of food cold chain (FCC) from 2001 to 2016 within different journals. The Scopus and Web of Science databases were taken into consideration to shortlist research articles. Henceforth, the authors scrutinized the FCC industry to offer some effective strategies to tackle the chain complexities. The authors also draw interwoven between FCC infrastructure, integration, stakeholders' interest, value addition, partners' performance and overall food cold chain performance (FCCP) into a conceptual framework.
Findings – This paper identifies four research gaps in the literature of FCC concerning the most popular approaches used for the FCCP measurement, the performance measurement metrics, the factors which negatively affect the FCCP and the main sustainability issues in FCC.
Originality/value – This study identifies RQs which represent possible areas of investigation to improve the body of the FCCP evaluation and management. Furthermore, the FCC practitioners, food authorities and researchers might find this review useful, as it draws a clear picture of research in the respective domain.

Keywords Africa, Sustainability, Supply chain, Literature review, Europe, Asia, Value addition, Food logistics, Supply chain processes, Performance measurements, Food cold chain

Paper type Literature review

1. Introduction

The world population is expected to reach 8.5 billion by 2030 and 9.5 billion in 2050 (UN DESA, 2015), which has imposed massive pressure on food supply chain (SC) worldwide. Globally, 1.3 billion tons food, the approximate cost of US$990 billion, is getting wasted every year. Indeed, the world's two fastest growing and highest populated countries China and India are failing to control the post-harvest food losses due to their inefficient food cold chain performance (FCCP) (Shabani *et al.*, 2012). Thus, large post-harvest losses intensify food

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insecurity and malnutrition. Research strongly advocated that in the world's poorest and food-inflated region of Sub-Saharan Africa, 1 percent mitigation in the food waste can foster the economic gain of US$40 million each year (The World Bank, 2011). Additionally, food wastage's carbon footprint is approximately at 3.3 billion tons of CO_2 per year (FAO, 2013).

The term cold chain (CC) is used to describe a particular SC whose activities and processes ensure the temperature control for the perishable products (Shabani *et al.*, 2015). It is to preserve the integrity and the quality of products and guarantees the shelf life of goods such as medicines, blood, flowers, fruits, vegetables, seafood, meat processed food product, dairy products, frozen food, etc. (Joshi *et al.*, 2011). Food cold chain (FCC) is a particular type of CC to keep the foodstuff in the proper condition. Therefore, food cold chain management (FCCM) consists of a set of SC practices aimed to preserve appropriate atmosphere for the perishable food products and defy microbial spoilage (Joshi *et al.*, 2011).

The FCC starts at farm level and embraces up to the consumer level. A conventional FCC infrastructure includes pre-cooling facilities, cold warehouses, refrigerated carriers, containers and packaging and traceability measurement tools (Joshi *et al.*, 2009; Montanari, 2008). The effective control over the FCC can generate numerous benefits for all chain partners, firms, customers and the society. Liao *et al.* (2011), for instance, insisted that sustainable perishable food consumption can prevent several micronutrient deficiencies and also chronic diseases such as heart disease, cancer, diabetes and obesity.

In the last decade, the demand for value-added food has witnessed a particular growth throughout the world (Shashi *et al.*, 2017). On the one hand, FCC plays a vital role in satisfying the growing demand for perishable foods (Ovca and Jevsnik, 2009). FCC is, therefore, promoting a concept of "Global Food Village" and facilitating food distribution in food-inflated countries. On the other hand, an improper FCCM increases the possible risk of potential microbial hazards, which may lead to food-borne illnesses (Ucar and Ozcelik, 2013; Rediers *et al.*, 2009; Jol *et al.*, 2007). According to World Health Organization's (2015) report, due to the consumption of contaminated food worldwide, each year around 600 million people (almost one in ten) fall ill, and around 420,000 people die. Furthermore, the CC's activities cause 1 percent of the total CO_2 emission in the world (Bozorgi, 2016; James and James, 2010).

The FCCP measurement is a cumbersome task because it has distinguishing features from the other types of SCs (Shabani *et al.*, 2012). An instance of such features is the supply and maintenance of various temperature levels for different products throughout different transport modes. Besides, FCC's barriers regarding infrastructure, cost, energy, technology and expertise potentially deteriorate the firms' efforts especially in the developing economies (Joshi *et al.*, 2012). As a consequence, effective planning, integration and information sharing are becoming critical success factors in moderation of the global food competition risk.

Value addition is becoming more of a necessity than an option to compete for customers who demand high-quality, fresh and healthy foodstuff. Value addition in the FCC framework defines actions to improve the firm's market share, goodwill and profitability through enhancement of the perishable products shelf life and decrease of the post-harvest loss rate (Aworh, 2015). Moreover, FCC value addition practices have a significant impact on overall firm performance. Hence, it is not merely a responsibility of focal firm, but it is the result of the collective efforts of all the SC's partners (Shashi *et al.*, 2017). FCC literature also indicates that the regular measurement and evaluation of partners' value addition practices has a greater importance than maintaining the efficiency of the chain (Maestr *et al.*, 2017; Minten *et al.*, 2016; Martinez, 2014).

Food safety needs an urgent attention as it has a significant impact on people's well-being, and consequently, the CC's active development is becoming a particular issue. However, the literature on FCCM has still limitations concerning the food safety (Joshi *et al.*, 2011) and no one has yet reported notable review on this domain. Basediya *et al.* (2013) and Montanari (2008) presented the review studies in the FCCM field, but both confined their

work to the logistical aspects. In particular, the majority of available CC literature is based on papers which conduct surveys or develop mathematical models (Hsiao and Huang, 2016; Saif and Elhedhli, 2016; Ucar and Ozcelik, 2013; Shabani *et al.*, 2011, 2012).

Based on the premises, this paper presents a literature review to shed light on the sources of uncertainty which have impeded the FCC growth. Primary research objectives of this paper are:

- to offer an analytical overview of the existing research in the field of FCC;
- to identify research gaps in the literature and define appropriate research questions (RQs) accordingly; and
- to propose a conceptual framework for FCCP measurement.

This structured literature review on the topic of FCC is indeed complementary to that of Laguerre *et al.* (2013) and by no means substitute their work. Laguerre *et al.* (2013) investigated the importance of food refrigeration to safeguard food quality along the SC. They presented state of the art in the deterministic and stochastic modeling approaches which control the transfer mechanisms of food refrigeration.

Section 2 of this paper explains the research methodology adopted to conduct the structured literature review. Section 3 illustrates the conceptual framework, and Section 4 presents the discussion. Finally, Section 5 presents conclusions, implications and limitations of the study.

2. Research methodology

In this paper, we propose a structured literature review dealing with different aspects of FCC. To do so, we followed the method suggested by Cerchione and Esposito (2016), which shows how to conduct a structured literature review. Indeed, the approach proposed by Cerchione and Esposito (2016) combines contributions of Easterby-Smith *et al.* (2012), Petticrew and Roberts (2006) and Pittaway *et al.* (2004) in conducting a systematic literature review. Accordingly, we organized our study into four phases:

(1) Phase of material search including the identification of keywords, the definition of search strings and the selection of the academic databases.

(2) Phase of papers selection according to definition of criteria for the inclusion and exclusion of a given papers in the review.

(3) Phase of descriptive analysis to provide reviewers with a preliminary analysis to categorize selected papers.

(4) Phase of content analysis to review papers, identify topic areas and research gaps and propose a conceptual framework.

We emphasize that the review process applied in our research is in line with the approach proposed by Tranfield *et al.* (2003). They have chosen a structured review approach conducted on manual filtering for the replicability and transparency to reduce bias in the findings of literature reviews. This method is a proper way of establishing selection criteria and assuring a more rigorous methodological scrutiny. The method also allows reviewers to get more insights from extant literature and provide an in-depth understanding of qualitative aspects rather than bibliometric analysis.

2.1 Phase of material search

As for the first step of the content search, we searched two databases (Scopus and Web of Science) to provide a high level of rigorousness. Since the FCC is a relatively new topic, we confined the review to the papers published from 2001 to 2016. The used keywords comprised

the strings "cold SC," "cold chain performance," "food cold SC," "cold logistic," "food traceability," "perishable food SC" and "sustainable food SC." In the initial search process, we found a total amount of 947 papers in the two databases excluding duplicates (Table I).

2.2 Phase of papers selection

Regarding the step of papers selection, we identified three criteria to compare the research papers against, so that the focus was the contributions close to the topic under investigation (Table II).

Using the selection criteria, we analyzed the initial sample of 947 papers via three reviewers and selected only the relevant papers. Taking the advice from Gunasekaran *et al.* (2015), we only selected papers published in peer-reviewed journals.

Three researchers read the abstracts of all 947 papers in parallel, and then selected 127 papers whose attention was FCC. They then read the selected papers in full to assure that the selected papers were fully relevant to the topic of investigation. In this phase, as a result, we excluded 49 papers and kept 78 papers. Reading the remaining papers in details and analyzing their references, we reach to 11 more papers to consider. Consequently, we included a total of 89 research papers for the subsequent phase of descriptive analysis.

We emphasize that the paper selection process applied in this paper is in line with Pittaway *et al.* (2004).

2.3 Phase of descriptive analysis

Concerning the descriptive analysis of the 89 selected papers, we defined the following aspects:

- papers over time;
- papers across journals;
- papers by publishers;
- papers by citations; and
- apers by methodology.

According to the distribution of the paper over time (Figure 1), the majority of contributions belongs to 2016 (15 papers). Similarly, the number of publications in 2015, 2014, 2013, 2012 is 13, 10, 8 and 8, respectively. The remaining 35 articles belong to the period between 2001 and 2011. We thus conclude that the research on FCC has taken significant attention in last

Keywords used	"cold supply chain" OR "cold chain performance" OR "food tractability" OR "perishable food supply chain" OR "sustainable food supply chain"
Date range	Published from 2001 to 2016
Total hits retrieved in Scopus and Web of Science databases excluding duplicates	948

Table I. Material search

First selection criterion: focus of the abstract	Abstracts focusing FCCM have been included
Second selection criterion: focus of the paper	Papers focusing on FCCM have been included
Third selection criterion: sample validation through cited references	Papers not included in the previous sample but cited in the literature on FCCM have been included

Table II. Selection criteria

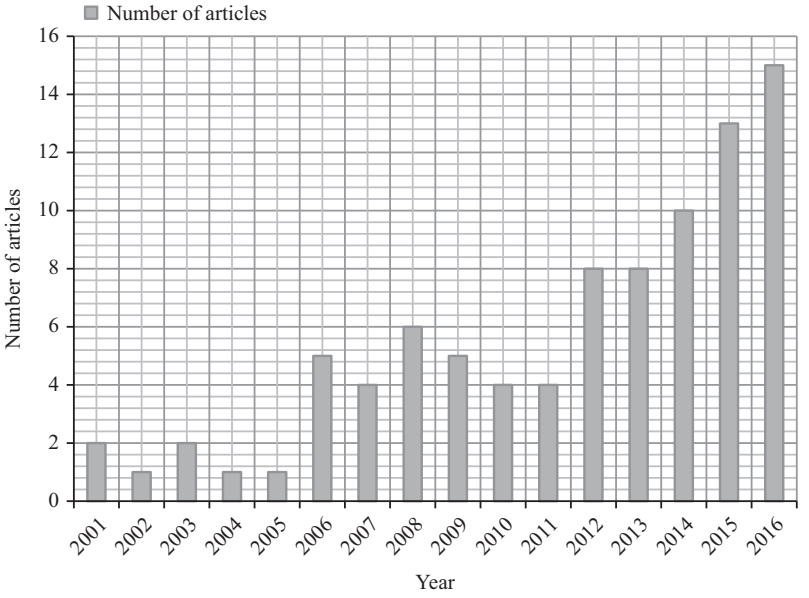

Figure 1.
Paper distribution over time

five years and prestigious journals have started to publish FCC-related topics in the same period. The trend of contributions on this subject is, therefore, growing in recent years.

Using the functionalities provided by the platform SCImago Journal Rank, we identified 11 journal subject areas (Table III), which are "agricultural and biological sciences," "chemistry," "business, management and accounting," "decision sciences," "engineering," "computer science," "economics, econometrics and finance," "energy," "environmental science," "mathematics" and "social sciences."

According to Larivière *et al.* (2015), FCC is a cross-road research topic focusing on different subject areas, including chemistry and energy, and which involves a variety of journals published in different countries by different publishers. For that reason, Neves and Da Silva (2016), Larivière *et al.* (2015) and Zolfani *et al.* (2015) suggested to categorize papers by publishers to better guide scholars/practitioners in finding those publishers who publish state of the arts in a given field. In addition, this categorization allows us to provide a citation index analysis by publishers. Figure 2 displays that Elsevier so far published 47 research papers, which is the highest number of the published FCC papers among publishers. Emerald, Wiley online, Taylor & Francis and Springer each contributes 19, 14, 6 and 2 papers, respectively. Inderscience stands at the bottom of the list with only one paper in print.

Table III highlights the important fact that the subject area "business, management, and accounting" has embedded the majority of papers focusing on FCC (42.7 percent). Moreover, the top-five publishers in the field of social science and humanities, which are identified by Larivière *et al.* (2015), have issued the largest number of papers (77.5 paper) in recent years.

Table IV reports the publisher-wise Web of Science citation and overall citation where we used Google Scholar and Web of Science databases. The results show that the papers published by Elsevier have an average 20.38 times cited in Web of Science and an overall citation of 63.93 times. These figures are, respectively, 25.57 and 116.89 for the papers appeared in Emerald's journals. Wiley online's papers have an average 15.35 times citations in Web of Science and 52.35 times citations overall. The average citation of papers published

Table III. Paper distribution by journals

Journal	Agricultural and biological sciences	Chemistry	Business, management and accounting	Decision sciences	Engineering	Computer science	Economics, econometrics and finance	Energy	Environmental science	Mathematics	Social sciences	Total
International Journal of Production Economics (IJPE)			●	●	●		●					12
Food Control (FC)	●	●										9
Agribusiness (A)	●						●				●	6
British Food Journal (BFJ)	●											6
Food Policy (FP)	●						●		●		●	3
Food Research International (FRI)	●											3
International Journal of Physical Distribution & Logistics Management (IJPDLM)			●	●						●	●	4
Production and Operations Management (POM)			●	●	●							3
Business Process Management Journal (BPMJ)			●									2
European Journal of Operational Research (EJOR)				●								2
Industrial Management & Data Systems (IMDS)			●		●	●						2
International Journal of Food Science and Technology (IJFST)	●				●							2

(*continued*)

Table III.

Journal	Agricultural and biological sciences	Chemistry	Business, management and accounting	Decision sciences	Engineering	Computer science	Economics, econometrics and finance	Energy	Environmental science	Mathematics	Social sciences	Total
Journal of Cleaner Production (JCP)			●		●			●	●			2
Postharvest Biology and Technology (PBT)	●											2
Production Planning & Control (PPC)			●	●	●	●						2
Supply Chain Management: An International Journal (SCM)			●									2
Trends in Food Science & Technology (TFST)	●	●										2
Vaccine (V)	●											2
Applied Mathematical Modelling (AMM)										●		1
Computers and Electronics in Agriculture (CEA)	●					●						1
Computer Standards & Interfaces (CSI)						●					●	1
Ecology of Food and Nutrition (EFN)	●								●			1
Energy Economics (EE)							●	●				1
Expert Systems with Applications (ESWA)					●	●						1
Food Bioprocess Technology (FBT)	●				●							1

(*continued*)

Journal	Agricultural and biological sciences	Chemistry	Business, management and accounting	Decision sciences	Engineering	Computer science	Economics, econometrics and finance	Energy	Environmental science	Mathematics	Social sciences	Total
Frontiers of Economics and Globalization (FEG)							●					1
International Journal of Operations & Production Management (IJOPM)			●	●								1
International Journal of Production Research (IJPR)			●	●	●							1
International Journal of Refrigeration (IJR)					●							1
International Journal of Shipping and Transport Logistics (IJSTL)			●	●							●	1
Italian Journal of Animal Science (IJAS)	●											1
Journal of Advances in Management Research (JAMR)			●									1
Journal of Business & Industrial Marketing (JBIM)			●									1
Journal of Food Science (JFS)	●											1
Journal of Food Science and Technology (JFST)	●											1
Journal of Operations Management (JOM)			●	●	●	●						1

(*continued*)

Table III.

Table III.

Journal	Agricultural and biological sciences	Chemistry	Business, management and accounting	Decision sciences	Engineering	Computer science	Economics, econometrics and finance	Energy	Environmental science	Mathematics	Social sciences	Total
Journal of Purchasing & Supply Management (JPSM)			●									1
Journal of Supply Chain Management (JSCM)			●			●	●					1
Maritime Policy & Management (MMPM)					●				●		●	1
Packaging Technology and Science (PTSRCR)		●			●							1
Resources, Conservation & Recycling (RCR)							●		●			1
International Journal of Logistics Management (TIJLM)			●								●	1

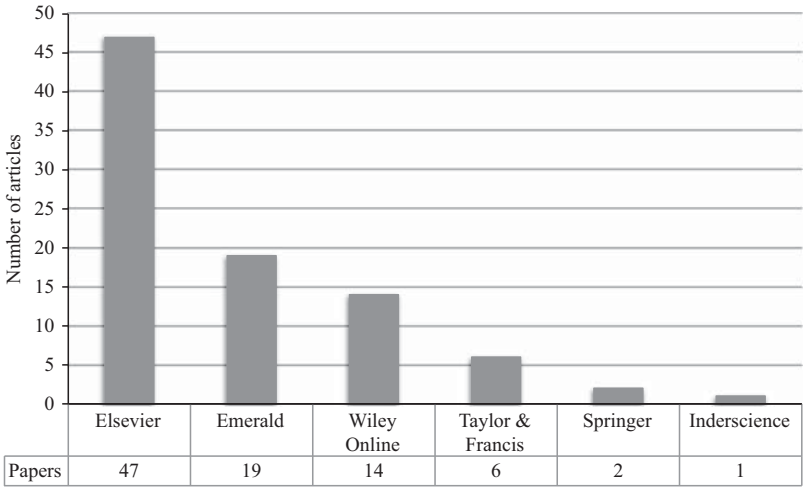

Figure 2.
Paper distribution by publishers

No.	Publisher	Web of Science citation	Overall citation	Average Web of Science citation (per paper)	Average overall citation per papers
1	Elsevier	958	2,911	20.38	63.93
2	Emerald	486	2,221	25.57	116.89
3	Wiley Online	215	733	15.35	52.35
4	Taylor & Francis	19	73	3.16	12.16
5	Springer	26	56	13.00	28.00
6	Inderscience	–	1	–	1

Table IV.
Citation index

by Taylor & Francis, Springer and Inderscience are 3.16, 13 and one in Web of Science and 12.15, 28 and one overall, respectively.

As for the adopted research methodology, the majority of papers have applied quantitative methods, while few papers have used qualitative or conceptual approaches (Figure 3).

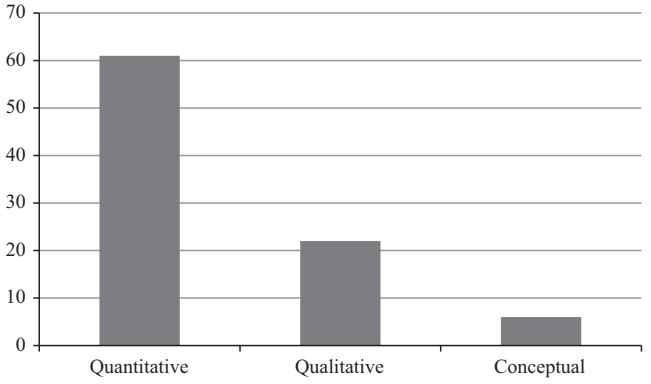

Figure 3.
Paper distribution by methodology

We divided the 61 papers whose methods are quantitative into 48 surveys, eight mathematical models, three optimization models, one simulation model and one statistical model. Regarding the 48 surveys, there are four different ways of collecting data: e-mail (37), online form (6), face-to-face (4) and by telephone (1).

The 22 qualitative papers are case studies with either single (8) or multiple (14) cases. The six conceptual papers are based on theoretical approaches already used in the field of FCCM. They do not use empirical data but secondary information.

2.4 Phase of content analysis

The content analysis of the 89 papers allowed us to provide a detailed overview of the FCC issues covered by the literature. More specifically, the selected papers have been categorized into four areas:

- Area 1—factors causing inefficient FCCP (32 papers).
- Area 2—FCC sustainability issues (24 papers).
- Area 3—key metrics for FCCP measurement (41 papers).
- Area 4—major FCCP improvement approaches (11 papers).

As reported in Table V, "key metrics for FCCP measurement" is the topic area gained the highest number of research papers, which is followed by the area dealing with

Topic area	References
1. Factors causing inefficient FCCP	Aguiar and Silva (2002)[a], Alonso and Northcote (2013), Ashok *et al.* (2017)[a], Baert *et al.* (2012), Balaji and Arshinder (2016), Basediya *et al.* (2013)[a], Cousins and Menguc (2006), Derens-Bertheau *et al.* (2015), Dijkstra *et al.* (2001), Gorton *et al.* (2006), Hsiao and Huang (2016)[a], James and James (2014)[a], Jevšnik *et al.* (2008), Joshi *et al.* (2009), Kitinoja (2013)[a], Kristensen *et al.* (2016), Kuo and Chen (2010)[a], Liao *et al.* (2011)[a], Minten *et al.* (2016)[a], Ovca and Jevsnik (2009), Papargyropoulou *et al.* (2014)[a], Rediers *et al.* (2009), Sahin *et al.* (2007)[a], Salin and Nayga (2003), Shabani *et al.* (2012)[a], Sharma and Pai (2015)[a], Shashi *et al.* (2017), Shukla and Jharkharia (2013)[a], Smigic *et al.* (2016), Thakur and Foras (2015), Ucar and Ozcelik (2013)[a], Zia (2007)
2. FCC sustainability issues	Aramyan *et al.* (2007)[a], Basediya *et al.* (2013)[a], Bozorgi *et al.* (2014), Chebolu-Subramanian and Gaukler (2015), Defraeye *et al.* (2015)[a], Esfahbodi *et al.* (2016)[a], Fritz and Schiefer (2008)[a], Haass *et al.* (2015), García-Arca *et al.* (2014), James and James (2010)[a], James and James (2014)[a], Kitinoja (2013)[a], Meneghetti and Monti (2015), Minten *et al.* (2016)[a], Plambeck (2012), Reuter *et al.* (2012), Roth *et al.* (2008), Sahin *et al.* (2007)[a], Saif and Elhedhli (2016)[a], Sharma *et al.* (2016)[a], Shin and Wang (2016), Shukla and Jharkharia (2013)[a], Ucar and Ozcelik (2013)[a], Zanoni and Zavanella (2012)[a]
3. Key metrics for FCCP measurement	Ageron *et al.* (2012), Aguiar and Silva (2002)[a], Aramyan *et al.* (2007)[a], Arduino *et al.* (2015), Ashok *et al.* (2017)[a], Aung and Chang (2014), Aworh (2015), Blackburn and Scudder (2009), Bogataj *et al.* (2005), Bourlakis *et al.* (2014), Chen *et al.* (2014), Costa *et al.* (2013), Defraeye *et al.* (2015)[a], Defraeye *et al.* (2016), Donk (2001), Donselaar *et al.* (2006), Engelseth (2009), Esfahbodi *et al.* (2016)[a], Fattahi *et al.* (2013)[a], Fritz and Schiefer (2008)[a], James and James (2010)[a], Jie *et al.* (2013), Ketzenberg *et al.* (2015), Kitinoja (2013)[a], Kumar *et al.* (2013), Kuo and Chen (2010)[a], Liao *et al.* (2011)[a], Likar and Jevsnik (2006), Lindgreen and Hingley (2003), Martinez *et al.* (2006), Martinez *et al.* (2007), Martinez (2014), McKinnon (1999), Montanari (2008), Nakandala *et al.* (2016)[a], Padilla-Zakour (2004), Sahin *et al.* (2007)[a], Saif and Elhedhli (2016)[a], Sharma *et al.* (2016)[a], Soni and Kodali (2011), Zanoni and Zavanella (2012)[a]
4. Major FCCP improvement approaches	Aiello *et al.* (2011), Fattahi *et al.* (2013)[a], Hsiao and Huang (2016)[a], Joshi *et al.* (2011), Joshi *et al.* (2012), Mai *et al.* (2011), Nakandala *et al.* (2016)[a], Saif and Elhedhli (2016)[a], Shabani *et al.* (2012)[a], Shabani *et al.* (2015), Sharma and Pai (2015)[a]

Table V.
Papers by topic area

Note: [a]These papers deal with more than one topic area

"factors causing inefficient FCCP." The two areas of "FCC sustainability issues" and "major FCCP improvement approaches" include 24 and 11 papers, respectively.

The first area includes 32 papers and deals with factors that might negatively affect FCCP. According to Joshi *et al.* (2009), the FCCM is not even an easy task in the developed countries, although they have the better SC infrastructure. In the context of emerging economies, the major bottlenecks for an efficient and effective management of the FCC are weaker logistics infrastructure, lack of cold storages, shortage of refrigerated carriers, high costs, improper traceability, the absence of integration, irregular information flow and the lack of expertise. (Balaji and Arshinder, 2016; Kitinoja, 2013; Shukla and Jharkharia, 2013; Shabani *et al.*, 2011, 2012; Kuo and Chen, 2010; Zia, 2007; Salin and Nayga, 2003). FCCP has also been hampered by the high use of obsolete equipment and machines which fail to deliver the protective benefit of recent designs (Ashok *et al.*, 2017). The scarcity of resources such as power and water required in FCC is another bottleneck (Joshi *et al.*, 2009). Jol *et al.* (2007) explicitly argued that insufficient knowledge to manage FCC operations is continuously increasing the food waste and food-borne illnesses.

In the last decade, researchers reported food safety and waste reduction as a collective responsibility of farmers, suppliers, processors, distributors and retailers. However, researchers recently underline the importance of the "customer responsiveness" in FCC (Derens-Bertheau *et al.*, 2015; Joshi *et al.*, 2010; Ovca and Jevsnik, 2009). These studies report that post-harvest wastage affects the environment, economy and hunger, therefore, the consumers are also responsible for the food safety. Here, a critical issue is the lack of consumers' knowledge about FCC. They usually do not pay attention to expiry date and purchase timing of perishable foods and are also unaware about the proper adjustment of refrigeration temperatures (Ucar and Ozcelik, 2013). This customer role in the FCC asks for integrated FCC processes from farmer to consumer to mitigate food wastage, improve health and assist the developing economies in contributing to international trade (Shashi *et al.*, 2017). Table VI summarizes the major constraints affecting FCCP in the developing economies.

The second area includes 24 papers and deals with FCC sustainability issues. Over the last decade, sustainability in the SC has received good heed to foster the "Triple Bottom Line" approach. Carter and Rogers (2008) defined sustainability in SC management as "the strategic, transparent integration and achievement of an organization's social, environmental and economic goals in the systemic coordination of critical inter-organizational business processes for improving the long-term financial performance of the individual and its SC." As Tseng *et al.* (2015) demonstrated, company's reputation along with their partners' value would be at risk if they are unable to justify their rational position in achieving sustainability. It is a surprising fact that early studies only focused on benefit aspect of FCC to sustain product life, freshness and reduce wastage. Nowadays, researchers have started reporting the FCC's negative impact on the environment (Saif and Elhedhli, 2016; Bozorgi *et al.*, 2014; James and James, 2010). They specifically consider the impact of the carbon emissions from food wastage, refrigerated trucks, cold storages, packaging and at the retail end. Meneghetti and Monti (2015) explained that the yearly rate of refrigeration energy is regularly increasing which in turn increases the carbon footprint. Cooling systems, moreover, utilize large quantities of hydrofluorocarbon gases that have high global warming potential (Saif and Elhedhli, 2016).

As discussed earlier, almost 1 percent of carbon emission is caused by the CC activities worldwide. In the UK, for example, the carbon emissions resulting from the CC processes represent approximately 3.5 percent of their total emission (Bozorgi, 2016). Emission reduction in CC could, therefore, be a win-win perspective for all chain members.

Moreover, the high use of pesticides/toxic materials in food products is another serious sustainability issue. Dandage *et al.* (2016) and Tse and Tan (2012) reported a dairy-product scan which revealed powder and saturated oil in the milk. Chebolu-Subramanian and

No.	Causes of inefficient FCC performance	References
1	Poor logistic infrastructure	Salin and Nayga (2003), Zia (2007), Joshi *et al.* (2009, 2012), FAO (2012), Shabani *et al.* (2012), Kitinoja (2013), Shukla and Jharkharia (2013), Papargyropoulou *et al.* (2014), Ashok *et al.* (2017), Balaji and Arshinder (2016), Shashi *et al.* (2017)
2	Lack of cold storages	Dijkstra *et al.* (2001), Aguiar and Silva (2002), Salin and Nayga (2003), Gorton *et al.* (2006), Zia (2007), FAO (2012), Joshi *et al.* (2012), Basediya *et al.* (2013), Kitinoja (2013), Shukla and Jharkharia (2013), James and James (2014), Papargyropoulou *et al.* (2014), Ashok *et al.* (2017), Balaji and Arshinder (2016), Minten *et al.* (2016), Shashi *et al.* (2017)
3	Shortage of refrigerated carriers	Rediers *et al.* (2009), Joshi *et al.* (2012), Shabani *et al.* (2012), Kitinoja (2013), Shukla and Jharkharia (2013), James and James (2014), Balaji and Arshinder (2016)
4	Lack of awareness about the use of IT	Joshi *et al.* (2009), Sahin *et al.* (2007), FAO (2012), Basediya *et al.* (2013), Sharma and Pai (2015), Ashok *et al.* (2017), Balaji and Arshinder (2016)
5	Unavailability of power and water	Joshi *et al.* (2009)
6	Lack of scientific harvesting methods	Gorton *et al.* (2006), Rediers *et al.* (2009), Basediya *et al.* (2013), Papargyropoulou *et al.* (2014), Balaji and Arshinder (2016)
7	Lack of integration	Sharma and Pai (2015), Balaji and Arshinder (2016), Cousins and Menguc (2006), Shashi *et al.* (2017)
8	High cost	Salin and Nayga (2003), Gorton *et al.* (2006), Kuo and Chen (2010), Alonso and Northcote (2013), Basediya *et al.* (2013), Kitinoja (2013), James and James (2014), Sharma and Pai (2015), Ashok *et al.* (2017), Kristensen *et al.* (2016)
9	Lack of modern processing and packing methods	Rediers *et al.* (2009), Papargyropoulou *et al.* (2014), Ashok *et al.* (2017), Balaji and Arshinder (2016)
10	Improper traceability	Joshi *et al.* (2009), Shabani *et al.* (2012), Thakur and Foras (2015), Ashok *et al.* (2017), Balaji and Arshinder (2016)
11	Lack of FCC expertise	Gorton *et al.* (2006), Joshi *et al.* (2009), FAO (2012), Kitinoja (2013), Sharma and Pai (2015), Ashok *et al.* (2017)
12	Improper handling	Gorton *et al.* (2006), Zia (2007), Rediers *et al.* (2009), Basediya *et al.* (2013), Kitinoja (2013), Shukla and Jharkharia (2013), Sharma and Pai (2015), Balaji and Arshinder (2016), Smigic *et al.* (2016)
13	Inadequate education of farmers	Joshi *et al.* (2009), Liao *et al.* (2011), Alonso and Northcote (2013), Basediya *et al.* (2013), Shukla and Jharkharia (2013), Smigic *et al.* (2016)
14	Lack of information sharing	Joshi *et al.* (2009), Papargyropoulou *et al.* (2014), Thakur and Foras (2015), Balaji and Arshinder (2016), Hsiao and Huang (2016)
15	Lack of standardization	Salin and Nayga (2003), Ashok *et al.* (2017), Balaji and Arshinder (2016)
16	Government regulation	Salin and Nayga (2003), Zia (2007), Joshi *et al.* (2009), Ovca and Jevsnik (2009), FAO (2012), Kitinoja (2013), Sharma and Pai (2015), Ashok *et al.* (2017), Minten *et al.* (2016)
17	Large number of intermediaries	Joshi *et al.* (2009), Baert *et al.* (2012), Shukla and Jharkharia (2013), Balaji and Arshinder (2016)
18	Lack of customer knowledge	Jevšnik *et al.* (2008), Ovca and Jevsnik (2009), Joshi *et al.* (2010), Ucar and Ozcelik (2013), Derens-Bertheau *et al.* (2015)

Table VI.
Factors causing inefficient FCCP

Gaukler (2015) also highlighted *Escherichia coli* outbreak from spinach and the *Salmonella* outbreak from tomatoes. These outbreaks have raised the health consciousness among consumers. As a result, food authorities have started evaluating companies' overall practices to protect consumers from the consumption of contaminated food (Martinez *et al.*, 2006).

As the companies reduce their rate of consumption, cut down on their overall waste, try to be more careful about costumers' health, they become more sustainable (Bourlakis *et al.*, 2014). We have accordingly identified some of the important FCC sustainability issues and reported

them in Table VII. Considering the problems displayed in Table VII, firms may generate benefits for both consumers and environment.

The third area includes 41 papers focusing on the main metrics for FCCP. In today's competitive business environment, performance management is one of the available tools for a firm to differentiate itself from its competitors. The SC performance measurement is an important subject for both practitioners and scholars. It allows for "tracking and tracing" of efficacy and efficiency failures and leads to more informed decision making about chain design (Singh *et al.*, 2016; Aramyan *et al.*, 2007). However, some issues, such as seasonal production, short shelf life, nature of product, large number of intermediates, refrigerated transportation and storage requirement, make FCCP management processes more complicated as compared to other SC models (Joshi *et al.*, 2012; Aramyan *et al.*, 2007). Temperature requirements vary between food items, whether frozen or chilled, and they even differ across types of foods. Even a short period of exposure, such as few hours of extreme hot or cold temperatures, can cause a marked decrease in shelf life and loss of quality (Aung and Chang, 2014). The temperature abuse in the FCC can cause microbial hazards and losses of product quality that can affect end consumer health (Bogataj *et al.*, 2005).

Traceability has a positive impact on inventory management, operational performance and reduction of reverse chain cost which influence the integrity of the FCC (Ringsberg, 2014). However, the stakeholders are progressively encouraging the FCC companies to improve sustainable performance (Shashi *et al.*, 2017). Thus, to fill the gap between expected and required FCC performance, stakeholders must look beyond FCC challenges to ensure sufficiency and efficiency of chain resources (Ashok *et al.*, 2017). In addition, stakeholders need to ensure on time and sufficient funding to implement FCC system improvements (Brenzel, 2015) that will minimize the FCC risks (Aung and Chang, 2014).

Scholars especially recommend companies relevant sustainability performance metrics to take authorities and customers into confidence (James and James, 2014; Zanoni and Zavanella, 2012). Meanwhile, exact route planning can reduce the lead time and waste rate. Due to the lack of (appropriate) performance management systems, nevertheless, there is usually limited understanding of FCCP (Ashok *et al.*, 2017). Although some studies propose different models for measurement of the SC performance, the models are not somehow applicable for FCCP. To enhance the understating about the sustainable FCCP measurement area, therefore, a list of FCCP metrics with important literature support is proposed in Table VIII.

The fourth area includes 11 papers focusing on the major FCCP improvement approaches. Few academics contribute to the FCCP improvement by applying different approaches (Saif and Elhedhli, 2016; Shabani *et al.*, 2012, 2015; Sharma and Pai, 2015; Fattahi *et al.*, 2013; Joshi *et al.*, 2012, 2011; Aiello *et al.*, 2011; Mai *et al.*, 2011). Aiello *et al.* (2011) proposed a methodology to measure the FCCP concerning expected quality of product at the retail outlets and to predict the expected fraction of perishable foodstuffs. Joshi *et al.* (2011) offered an FCCP benchmarking framework to reveal firm's strengths and weaknesses so that the areas of improvement are known. Joshi *et al.* (2012) identified the key performance factors and key decision attributes to measure the FCCP to implement continuous improvement.

In the same way, Shabani *et al.* (2011) introduced an innovative data envelopment analysis model to select refrigerated containers in FCC. By considering a sales agent as an important factor for FCCM, Shabani *et al.* (2012) extend a linear pair model for the selection of the best sales agents for benchmarking. Fattahi *et al.* (2013) analyzed the characteristics and performance of the meat SC and developed a performance model. Shabani *et al.* (2015) developed a new procedure to tackle the vehicle selection problem in FCC. Sharma and Pai (2015) reported the interdependencies between various FCCM factors.

	Waste reduction	Emission reduction	Energy consumption reduction	Water consumption reduction	Toxic material reduction	Eco-labeling	Green packaging	Use of eco-friendly refrigerants	Cost reduction	Recycling
Aramyan *et al.* (2007)	●	●	●	●	●		●		●	●
Sahin *et al.* (2007)	●				●					●
Fritz and Schiefer (2008)	●	●	●	●	●		●		●	
Roth *et al.* (2008)	●	●			●					
James and James (2010)	●	●	●	●	●			●	●	●
Plambeck (2012)		●	●							
Reuter *et al.* (2012)	●	●	●						●	●
Zanoni and Zavanella (2012)	●	●	●						●	●
Basediya *et al.* (2013)	●	●	●	●			●		●	●
Kitinoja (2013)	●	●	●	●	●		●	●	●	●
Shukla and Jharkharia (2013)	●	●	●	●	●		●	●	●	
Ucar and Ozcelik (2013)	●			●	●					●
Bozorgi *et al.* (2014)		●	●					●	●	
García-Arca *et al.* (2014)	●				●		●			
James and James (2014)	●	●	●		●	●	●	●	●	
Chebolu-Subramanian and Gaukler (2015)	●		●		●		●		●	
Defraeye *et al.* (2015)	●	●	●	●	●		●		●	●
Haass *et al.* (2015)	●	●	●					●	●	●
Meneghetti and Monti (2015)	●	●	●				●	●	●	●
Esfahbodi *et al.* (2016)	●	●	●	●	●	●	●		●	
Minten *et al.* (2016)	●	●	●	●					●	●
Saif and Elhedhli (2016)		●	●							●
Sharma *et al.* (2016)	●	●	●	●	●	●	●	●	●	●
Shin and Wang (2016)	●	●	●			●	●	●	●	

Table VII.
FCC sustainability issues

No.	Performance metrics	Definition	References
1	Carbon emission reduction	The total reduction rate of carbon emission during production, warehousing and transportation process	Aramyan *et al.* (2007), Saif and Elhedhli (2016), Fattahi *et al.* (2013), Defraeye *et al.* (2015), Esfahbodi *et al.* (2016), Sharma *et al.* (2016)
2	Energy consumption reduction	The total reduction in energy consumption throughout the FCC	Fattahi *et al.* (2013), Defraeye *et al.* (2015, 2016), Esfahbodi *et al.* (2016), Sharma *et al.* (2016)
3	Water consumption reduction	The total reduction in water consumption during the FCC process	Fattahi *et al.* (2013), Defraeye *et al.* (2015), Esfahbodi *et al.* (2016)
4	Food waste reduction	The total reduction in food waste throughout the FCC	Bourlakis *et al.* (2014), Ketzenberg *et al.* (2015), Sharma *et al.* (2016), Shashi *et al.* (2017)
5	Reduction of solid waste	The total reduction in solid, semisolid, and high density liquid waste, including smelt residues, fly ash, bottom ash and gangue	Esfahbodi *et al.* (2016)
6	Reduction in hazardous/ harmful/toxic material use	Total reduction in the use of hazardous/harmful/toxic material throughout the FCC	Aramyan *et al.* (2007), Liao *et al.* (2011), Esfahbodi *et al.* (2016)
7	Shelf life	The length of time a packaged food will last without deteriorating	Donselaar *et al.* (2006), Martinez *et al.* (2006), Aramyan *et al.* (2007), Montanari (2008), Defraeye *et al.* (2015), Nakandala *et al.* (2016)
8	Cooling rate	The cooling as per product requirement	Defraeye *et al.* (2015, 2016)
9	Shipping accuracy rate	The number of orders delivered properly as ordered	Donk (2001), Aramyan *et al.* (2007), Fattahi *et al.* (2013), Bourlakis *et al.* (2014), Arduino *et al.* (2015), Sharma *et al.* (2016)
10	Lead time	Time taken to deliver an order	Donk (2001), Bogataj *et al.* (2005), Donselaar *et al.* (2006), Aramyan *et al.* (2007), Blackburn and Scudder (2009), Fattahi *et al.* (2013), Bourlakis *et al.* (2014), Arduino *et al.* (2015), Ketzenberg *et al.* (2015), Nakandala *et al.* (2016)
11	Green packaging	Percentage use of eco-friendly packaging materials and green packaging design by the enterprises	Aguiar and Silva (2002), Montanari (2008), Fattahi *et al.* (2013), Defraeye *et al.* (2015), Esfahbodi *et al.* (2016)
12	Traceability	Consistency to trace the history, application or location of a product using recorded identifications	Aguiar and Silva (2002), Sahin *et al.* (2007), Engelseth (2009), Costa *et al.* (2013), Bourlakis *et al.* (2014), Nakandala *et al.* (2016)
13	Product quality & safety	The quality of the products being healthy and nutritious. The product does not exceed tolerable rate of risk related to pathogenic organisms or chemical and physical hazards such as microbiological, chemical	Aguiar and Silva (2002), Lindgreen and Hingley (2003), Padilla-Zakour (2004), Likar and Jevsnik (2006), Martinez *et al.* (2006, 2007),Aramyan *et al.* (2007), Fattahi *et al.* (2013), Jie *et al.* (2013), Aung and Chang (2014), Bourlakis *et al.* (2014), Chen *et al.* (2014), Martinez (2014), Aworh (2015), Defraeye *et al.* (2015), Nakandala *et al.* (2016), Shashi *et al.* (2017)
14	Recycling rate	Collected used product from crop, packaging, etc., that is disassembled, separated and processed into recycled products, components and/or materials or reused, distributed or	Aramyan *et al.* (2007), Fattahi *et al.* (2013), Sharma *et al.* (2016), Esfahbodi *et al.* (2016)

(*continued*)

Table VIII.
Sustainable FCC indicators

No.	Performance metrics	Definition	References
		sold as used, without additional processing	
15	Machine breakdown	Number of times machine breakdown disturbance occurs that negatively affect the production and maintenance of temperature during chain processes	Kuo and Chen (2010), Fattahi *et al.* (2013), Ashok *et al.* (2017)
16	Passive FCC rate	The use of eco-friendly refrigerants and transportation modes to store and deliver orders, respectively	Ageron *et al.* (2012), Kitinoja (2013), Esfahbodi *et al.* (2016), Sharma *et al.* (2016)
17	Temperature monitoring errors	The sum of wrong temperature monitoring	Bogataj *et al.* (2005), Ashok *et al.* (2017), Defraeye *et al.* (2016)
18	Total FCC cost	Combined costs of raw materials, warehousing, energy, maintenance, labor, and distribution, including transportation and handling cost	Bogataj *et al.* (2005), Sahin *et al.* (2007), Montanari (2008), Blackburn and Scudder (2009),Fattahi *et al.* (2013), Bourlakis *et al.* (2014), Ketzenberg *et al.* (2015), Nakandala *et al.* (2016), Saif and Elhedhli (2016)
19	Inventory levels	A firm's merchandise, raw materials, finished and unfinished products which have not been sold yet	Donselaar *et al.* (2006), Aramyan *et al.* (2007), Fattahi *et al.* (2013)
20	Inventory holding days	For the number of days, an inventory is remained unprocessed and placed in warehouses and production point	Donselaar *et al.* (2006), Fattahi *et al.* (2013)
21	Customer satisfaction	The level to which the customers are satisfied with the consumption of products/services	Aramyan *et al.* (2007), Soni and Kodali (2011), Ageron *et al.* (2012),Fattahi *et al.* (2013), Kumar *et al.* (2013), Bourlakis *et al.* (2014), Defraeye *et al.* (2015), Sharma *et al.* (2016)
22	Total cost reduction	Total reduction in combined costs of raw materials, warehousing, energy, maintenance, labor,and distribution, including transportation and handling cost as compare to last year	James and James (2010), Fritz and Schiefer (2008), Zanoni and Zavanella (2012), Esfahbodi *et al.* (2016),
23	Growth in market share	The rate at which firm's market share is growing	Martinez *et al.* (2006), Fattahi *et al.* (2013), Sharma *et al.* (2016)
24	Empty running	The distance the vehicle traveled empty	McKinnon (1999)
25	Fuel efficiency	On a litre per km basis and averaged across the fleet on an annual basis	McKinnon (1999)

Table VIII.

Saif and Elhedhli (2016) extended a new hybrid simulation-optimization approach for solving the environmental concerned FCC problems. In the meantime, all these studies unanimously manifest that more systematic research efforts are required to attain "Triple Bottom Line" FCCP. Table IX indicates the approaches proposed by researchers to improve the FCCP.

3. Conceptual framework based on the literature

In this section, we develop a conceptual model (see Figure 4) to embrace all the claims reviewed in Section 2.4 to provide directions for the further investigation. The idea of such a model could be interesting from two viewpoints. First, it summarizes 15 years of research on FCCM and combines different perspectives of FCCM into one unique model. Second, other researchers may adopt the model in their works and, if necessary, integrate it into the new empirical investigations.

Reference	Sensitivity analysis	Kinetic approach	Delphi	Bayesian networks	Simulation	Data envelopment analysis	Fuzzy genetic algorithms	Structural equation modeling	Twin graph
Aiello *et al.* (2011)					●				
Joshi *et al.* (2011)			●						
Mai *et al.* (2011)		●							
Shabani *et al.* (2011)						●			
Joshi *et al.* (2012)	●								●
Shabani *et al.* (2012)						●			
Fattahi *et al.* (2013)			●						
Shabani *et al.* (2015)						●			
Sharma and Pai (2015)				●					
Hsiao and Huang (2016)				●				●	
Nakandala *et al.* (2016)					●		●		
Saif and Elhedhli (2016)					●				

Table IX.
Major approached used for FCC improvement

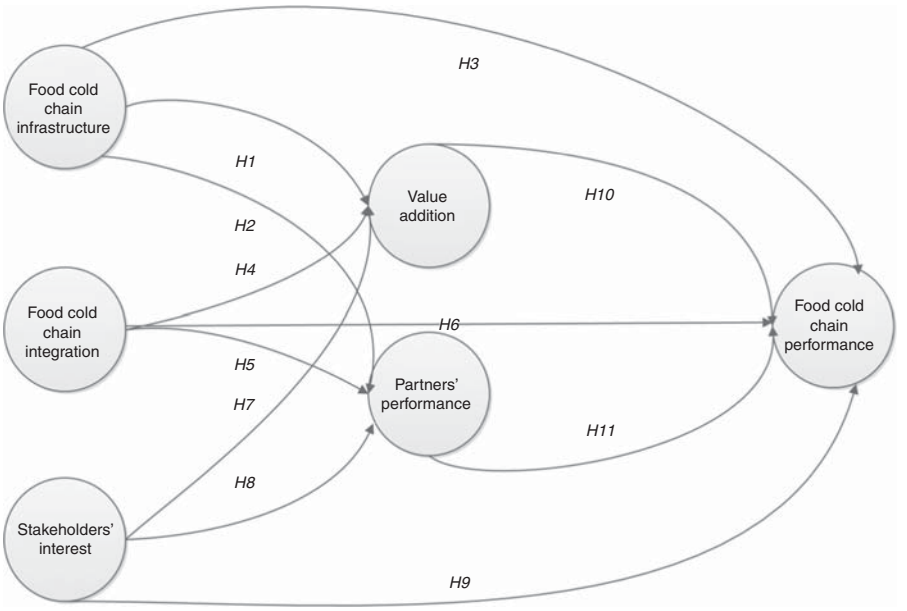

Figure 4.
Conceptual FCCP measurement model

The following sections illustrate the proposed framework, which consists of five factors, namely FCC infrastructure, FCC integration, stakeholders' interest, value addition and partners' performance. The interrelationships between the mentioned factors as well as their effect on the FCCP are discussed in detail.

3.1 FCC infrastructure, value addition, partners' performance and FCC performance

Infrastructure is the primary input to run FCC operations efficiently and with minimum interruption. Well-developed FCC infrastructure enables firms to improve product's quality and reduce quantity losses, lead time and costs (Kitinoja, 2013). The major difference between FCCP in the developed and developing countries is related to the support of the infrastructure, the use of facilities and the availability of equipment. Such a difference has resulted in inefficient FCCP in the developing countries, while FCCP in the developed countries is productive (Parfitt *et al.*, 2010; Viswanadham, 2006). On the one hand, old roads, obsolete transportations and inefficient production points increase both the delivery and the manufacturing lead time (Shabani *et al.*, 2015; Aung and Chang, 2014). Abolished equipment causes high food wastage, delivery of poor-quality product, the high cost of manufacturing, transportation and cooling, and customer dissatisfaction (FAO, 2012; Joshi *et al.*, 2009; Zia, 2007). On the other hand, capable information system as an important FCC infrastructure has a positive impact on firm's responsiveness to customers and financial performance (Jayaram *et al.*, 2000). The reason is that electricity and IT infrastructure should sufficiently be available to support FCC's operations (Balaji and Arshinder, 2016). Many studies blame the lack of modern food processing infrastructure as a primary reason behind the small food processing rate and supply of non-value-added products (Shashi *et al.*, 2017; Shabani *et al.* 2015; James and James 2014; Basediya *et al.*, 2013). The availability of FCC warehouses and distribution center enables FCC firm to store production in larger volume and keep it for a longer period to better deliver downstream partners' demand (Minten *et al.*, 2016). The use of cold storages and refrigerated trucks can also undergird the distribution system (Ashok *et al.*, 2017;

Minten *et al.*, 2016). Logistics infrastructure should, therefore, be capable of supporting distribution within minimum possible lead time (FAO, 2012; Joshi *et al.*, 2009; Zia, 2007). The major contributors to the perishable food waste in the SC are old and careless food processing systems, the absence of cold warehousing facilities, process contaminations, inadequate packaging equipment, transportation losses and high inventory level due to the weak forecast (Papargyropoulou *et al.*, 2014). The absence of appropriate FCC facilities hinders the value addition efforts and leads to poor FCCP (Rediers *et al.*, 2009). From the above arguments, it is clear that without improvement in CC infrastructure, the firm cannot satisfy their customers and attain superior FCCP. As a result of the above discussion, we propose that:

H1. FCC infrastructure affects value addition.

H2. FCC infrastructure affects partners' performance.

H3. FCC infrastructure affects FCC performance.

3.2 FCC integration, value addition, partners' performance and overall performance

The SC literature identifies both internal and external integration as critical success factors to achieve competitive advantage and improves chain performance (Sharma and Pai, 2015; Jie *et al.*, 2013). According to Cagliano *et al.* (2006), the integration enables the firm to have original ideas to better serve customers, and therefore generate customer value advantage. Collaborative relationship facilitates information sharing, which assists in understanding and responding customers' need well before competitors (Cai *et al.*, 2010; Fabbe-Costes and Jahre, 2008; Koufteros *et al.*, 2005). Information sharing also strengthens the SC decision making and its implementation (Engelseth, 2009). The sharing of available technology, logistics, packaging and information assist FCC partners in tackling the inefficiencies of the inventory, cost, wastage, lead time and in reacting to the rising demand at the right time (García-Arca *et al.*, 2014; Flynn *et al.*, 2010). Researchers strongly advocate that integration promotes customers' responsiveness, maximize the rate of on-time delivery and minimize cycle time that offers cost advantage (Fritz and Schiefer, 2008; Lindgreen and Hingley, 2003). Chang *et al.* (2015) argued that in SC, each task should be performed by the firm that does it best. If upstream partners provide low quality of raw material, the quality of final products will also be poor (Shashi *et al.*, 2017; Ageron *et al.*, 2012). SC integration is positively associated with firm's operational performance which further assists in attaining paramount financial results (Chang *et al.*, 2015). Ataseven and Nair (2017) pointed out that customer integration, supplier integration and internal integration are positively related to aggregate firm performance, operational performance and financial results. As a result of the above discussion, we surmise as follows:

H4. FCC integration positively affects value addition.

H5. FCC integration positively affects partners' performance.

H6. FCC integration positively affects FCCP.

3.3 Stakeholder interest, value addition, partners' performance and overall performance

In SC, stakeholders include suppliers, employees, government, financial institutions, third-party logistics providers, distributors, retailers and customers. The stakeholder theory advocate that in the long term, firms that value and manage their stakeholders' interests are more successful as compared to those that do not (Freeman and Liedtka, 1997). According to Co and Barro (2009), each stakeholder provides resources to the focal firm that somewhere

impact to overall company's performance. Literature supports the positive relation between the stakeholder pressure and the firm performance, for example in the SC risk reduction (Kumar *et al.* 2013; Reuter *et al.*, 2012; Baert *et al.*, 2012). Meanwhile, retailer pressure is positively associated with the SC improvement which adds value to the customer and improves market and financial performance (Martinez *et al.*, 2007). With effective stakeholder management, a firm performs much better as compared to the competitors in the mean of better decision making, information sharing, resource utilization, cost reduction, demand fulfillment and customers' services, etc. (Greenley and Foxall, 1997). Stakeholders influence the gain of SC partners and sustain competitive advantage (Reuter *et al.*, 2012). Empirical evidence is also available on the fact that corporate governance and employee management are positively related to overall business performance (Galbreath, 2006). The focal firm, therefore, needs novel strategies to manage stakeholder along SC efficiently. Based on the above discussion, we may claim that:

H7. Stakeholder interest positively affects value addition.

H8. Stakeholder interest positively affects partners' performance.

H9. Stakeholder interest positively affects FCCP.

3.4 Value addition and FCCP

Value addition is a prerequisite for a successful business because it has a direct impact on firm's market, customer and financial performance (Shashi *et al.*, 2017; Aworh, 2015; Martinez, 2014). The improved chain efficiency, customer services rate, product quality, availability, affordability, consumption rate and higher customers satisfaction, waste minimization, waste utilization, reduced cost and lead time and strong competitive advantage in marketplace are only some of the outcomes of value addition practices in the SC (Maestr *et al.*, 2017; Aworh, 2015; Chang *et al.*, 2015; Martinez, 2014; Alonso and Northcote, 2013; Joshi *et al.*, 2009). Kumar *et al.* (2013) emphasized that the greater the customer's value, the higher the satisfaction of the client and loyalty. Moreover, value addition perception supports the sustainability, which mitigates energy crisis, waste rate and environmental pollution and builds sustainable firm image and jolts the demand (Ashok *et al.*, 2017; Ageron *et al.*, 2012; Padilla-Zakour, 2004). Shashi *et al.* (2017) provided empirical evidence that the value addition of upstream SC partner has substantial positive impact on value addition of SC downstream. Value addition practices in the SC can be a win-win strategy for all chain members (Alonso and Northcote, 2013). These claims lead us to hypothesize that:

H10. Value addition positively affects FCCP.

3.5 Partners' performance and FCCP

In SC, members' success is a significant predictor of the overall SC performance (Ageron *et al.*, 2012). The inefficient performance of one player, therefore, hinders the performance of the other members and causes inferior SC performance. Cost reduction at suppliers' end assists in minimizing the final product cost and generates values for customers (Aramyan *et al.*, 2007). Likewise, the supply of high-quality material and on-time deliveries by partner enables sellers to meet the customers' expectations (Ageron *et al.*, 2012). Delays in material delivery, on the contrary, not only reduces the product quality and but also increases manufacturing lead time, which may increase the total cost as well as customer's dissatisfaction (Cai *et al.*, 2010). An adulterated milk outbreak by the Shanlu Group in 2008 is one of the best examples which reports the impact of partner firms' performance on the FCC overall performance (Chen *et al.*, 2014). The supply of timely and reliable information by

partners to the focal firm strengthen the decision making, resources utilization and demand management (Kuo and Chen, 2010), while the partners' opportunistic behavior has an adverse impact on the firm's performance (Salin and Nayga, 2003). Considering the above discussion, we hypothesize that:

H11. Partners' performance positively affects FCCP.

4. Discussions

The study's finding indicates that research on FCCM has currently been shifting toward sustainable FCCM to save money, the environment, food and achieve social benefits. The sustainable FCC practices are visible among the developed countries, whereas it is not in the developing economies. World environment authorities need to evaluate the FCC practices of the emerging economies and should force/motivate them to meet the "Triple Bottom Line" standards. However, firms seeking to alleviate their greenhouse gas emission often realize that their direct carbon emission is an underestimation of the actual carbon emitted in the SC (Plambeck, 2012). The application of the new technologies and systems would boost the efficiency of the logistics, and in the meanwhile, use of more energy efficient refrigeration technologies would assist practitioners to maintain the product quality and quantity, and confine the carbon emission. Companies should highly prioritize the use of carbon-free energy sources for the sustainability purpose. Besides, both the routine equipment maintenance and skilled human resources are essential to mitigate the problem of temperature breakdowns and monitoring errors.

Farms and markets are highly fragmented, which leads to an increasing number of chain intermediates, resulting in high lead time, cost, waste, order return, complaints and customers' dissatisfaction. Thus, it is advisable that the development of direct marketing system or supply of products directly from the farm to processor or market, without the involvement of intermediates, would be beneficial to prolong product life and efficiently deal with unexpected complexities. Skipping over the unnecessary intermediates in FCC would generate significant income to farmers and also better quality and price to the consumers. In the same vein, innovative product packaging would strengthen the distributors and ensure the product integrity. Customers demand unbranded food product just for cost reasons (Joshi *et al.*, 2009), meaning that they underestimate the risk of getting a food-borne infection after the consumption of contaminated food. The sellers, therefore, need to trade organized retail food products to deliver healthy food consumption experience to their customers. This study recommends the cost reduction at each FCC intermediate point can enable firms to offer branded food products at minimal possible cost. It would allure more customers and maximize the company's market share, goodwill, customer retention and keep pace with the competition.

The governments should encourage private investments to upgrade the FCC infrastructure. Undoubtedly, reducing FCC barriers would lessen the prices and thus, offer consumers cheaper and healthier access of processed and unprocessed food products. Besides, the firm should emphasize on lean processing, reducing packaging materials, achieving ISO 14001 certification and recycling. Such practices would give companies an administrative as well as stakeholder support. Nevertheless, the lack of FCC logistics infrastructure is not only an awful reality, but the lack of chain integration, coordination, information sharing, shipping accuracy and knowledge are other major bottlenecks that have restrained the FCC industry growth. Integrated IT structure would be a good remedy to resolve these inefficiencies and shape and reshape business strategies. The IT integration will undoubtedly lead toward coherent demand measurement, avoid over-production, reduce inventories and improve service quality. The study findings affirm that in the developing countries, both the chain partners and customers are unaware of the right perishable products handling methods. Handlers do not know the manifestation of bacterial

growth and incidence in food (Smigic *et al.*, 2016). Thus, both the governmental and non-governmental organizations need to play crucial roles in arranging the post-harvest food handling seminars and training programs to bridge this knowledge gap. This review supports the finding of Liao *et al.* (2011) in the sense that farmers' awareness and pesticide residue testing require particular attention.

Irresponsible companies, surprisingly, are omitting sustainable performance theme for the sake of short-term profits. Based on the review findings, it can be inferred that the significant mitigation in waste, emission, energy consumption, cost, use of toxic materials and enlargement in the rate of recycling, use of eco-labeling, green packaging and eco-friendly refrigerants in FCC operations are requirements rather than merely a choice. The UK and Brazil have taken promising initiatives, and significantly minimized the rate of energy consumption in domestic refrigerators and freezers (James and James, 2010). Herein, the use of energy labeling could be a valuable method of minimizing energy consumption.

Ageron *et al.* (2012) suggested that firms cannot run their business longer with the inefficiencies of chain partners. The lack of coordination of FCC processes is creating the gap between actual and desirable FCCP. Both the external and internal integration could improve delivery reliability, flexibility and service rate. In the food sector, one of the major environmental impacts of post-harvest waste belongs to its final disposal. If the firms develop adequate infrastructure for waste disposal, there would be the numerous opportunities for energy harvesting and nutrient cycling using composting facilities (Balaji and Arshinder, 2016).

In managing FCC, the existence of an effective performance measurement program is crucial, such that if there is not any FCCP measurement method, there would not be any chance of improvement. From a practical perspective, the need to outline FCCP indicators with standardized terminology is highly necessary to create a standard performance measurement understanding among different FCC's members. The firms need to find a set of the major performance indicators to properly track and trace their own as well as their partners' productivity. Indeed, the routine evaluation will assist in highlighting the pitfalls and after that enable firms to come with better strategies. This study, therefore, represents a significant contribution to identifying those factors which cause ineffective FCCP, create sustainable FCC, list key performance measurement metrics and extant performance measurement approaches.

5. Concluding remarks

In this paper, we carried out a structured literature review about FCC, which is, to the best of the authors' knowledge, the first study covering almost all aspects of FCC. The detailed analysis offers an overview of the papers from the literature, which has provided a useful summary of the studies on the topics such as FCC, FCCM and FCCP. The descriptive analysis has particularly highlighted that the FCCM is an interdisciplinary research area whose papers have appeared in a variety of journals with different aim and scopes.

The content analysis of the papers included in this literature review has provided an overview of the main issues covered by research on the cold SC management. The paper has highlighted four areas of investigation: factors causing inefficient FCCP, FCC sustainability issues, key metrics for FCCP measurement and major FCCP improvement approaches. As a result of this review, we have found four research gaps for which we have defined the following RQs:

RQ1. Which factors are responsible for inefficient FCCP in the developing countries?

RQ2. What are the major FCC sustainability issues?

RQ3. What are the most promising sustainable FCCP measurement metrics?

RQ4. What are the primary methods/approaches for FCCP measurement?

These RQs represent a study agenda to improve the body of knowledge in the field of FCCM. We additionally propose a conceptual FCCP measurement framework with the provision of useful hypotheses for future research.

This review is the first systematic attempt to review FCC. It goes without saying that other forms of CC such as floriculture, chemical and pharmaceutical require further investigation. Future studies may, therefore, address the mentioned issues in full detail.

The population growth and the scarcity of resources needed to meet the increasing needs of people require a great attention from institutions and stakeholders. Based on the previous discussions, there emerges the need of political issues and feasible guidance by the government to enact policies able to guarantee high-quality standard in the management of FCC. Infrastructure of FCC and, consequently, the supply network integration, the partners' performance and the stakeholders' interests are deeply influenced by the policies implemented by the central governments, since they are responsible for resources allocation. Therefore, they have to establish policy enforcement and offer incentives and favorable measures to regulate and promote the FCCM. The best use of policy measures will also preserve the safety of the population.

This literature review allows us to identify several implications among factors influencing FCC and its performance and highlights the pivotal role of partners' performance in FCCP. However, applying the proposed sustainable FCCP measurement model over real-life data would be an interesting topic for the future study. Accordingly, one may collect data from different national/international companies using surveys, and employ structural equation modeling approach, so that the proposed framework will be strengthened. If one or more of the hypothesis is validated, this study will offer appropriate strategies for FCCM. This way policymakers can identify the weaknesses of FCCM and then determine specific policies to support its competitiveness. The result of this study may have grave implications for both regional and national development, regarding the impact on global logistics, shipping activities of foods and environmental policies. Moreover, the results may inspire firms to promote the integration of the entire SC partners for a common goal and improve the overall performance of the network.

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Corresponding author
Amir Shabani can be contacted at: a.shabani@vu.nl